

Preface

In keeping with renewed emphasis within IBM to accelerate delivery of solutions to the marketplace, IBM's Research Division has implemented a Services, Applications, and Solutions (SAS) strategy by which resident technologies and skills are brought to bear on customer problems through means which lie outside traditional product lines. This strategy comprises a collaboration among the Research Division, worldwide Industry Solution Units, other IBM divisions, and customers from a broad range of industries. Its aim is to develop industry-specific solutions, advanced applications, and key enabling technologies, across many industry segments, which possess replicable components and provide unique value and competitive edge to IBM's customers.

Direct interaction of research scientists and engineers with customers and the details and constraints of their problems provides a unique opportunity for broadening the scope and enhancing the value of research by bringing it from the realm of theory into the realm of practical operation. In pursuing this strategy, the Research Division continues to fulfil its charter of being famous for its science and of value to the IBM Corporation.

This special issue of the *IBM Journal of Research and Development* contains papers describing a variety of solutions which are a result of SAS activity. The emphasis in some of the papers on applications over the technology itself is due to the nature of the issue topic and our corresponding instructions to the reviewers of the papers.

The first paper in this sampling, by Mintzer et al., discusses the application of network servers, databases, digital storage, image processing, and many other technologies to create a global digital library. In this case, the library permits access to an important collection from the Vatican Library by selected scholars. Many unique problems have been addressed, such as the protection of rare, invaluable items from damage and from misappropriation, and the faithful capture of images with sufficient detail for scholarly study. The potential of global digital libraries seems limitless.

The second paper, by Gopisetty et al., deals with a variety of image-processing techniques used for the automatic processing of scanned paper forms by a variety of customers, i.e., replacing manual key-entry by automatic means of information capture. The forms include income-tax forms, insurance-company forms, "giro" payment forms, and many others. The collection of image-processing technology used is very broad, including means for recognizing the type of form being processed, extracting the handwritten or typed information from the total image (in order to reduce the amount of memory necessary to store the image), and recognizing the written or typed characters and words. The monetary savings by

performing form processing automatically rather than manually are enormous, involving billions of dollars.

The next two papers deal with medical applications of R&D. The first of these, by Taylor et al., describes a variety of applications for computer-integrated surgery, the combination of medical-imaging technology and precise, accurate position sensing during surgery to augment the surgeon's ability to manipulate surgical instruments. Among the applications discussed are total hip replacement surgery performed by robot, pre-operative planning to move bone fragments during craniofacial surgery, and alignment of images from various imaging technologies. The technologies employed are myriad, and the benefits associated with improved accuracy and lessened trauma during surgery are extensive.

The other paper related to medical applications, by Ohbuchi et al., describes the integration of a large, heterogeneous network of computer systems used for cancer care in Japan. Two components are described in detail—the medical-image database and the synthetic environment. The former handles a large variety of image types (X-rays, CAT scans, MRIs, ultrasound images, etc.) and facilitates their capture, display, storage, and distribution. The very large volume of information to be handled posed a major engineering challenge the system had to overcome. The synthetic environment subsystem, used primarily to train surgeons in neurosurgery and to prepare surgeons for specific impending operations, is flexible enough to be easily adapted for a variety of other applications.

The final paper, by Lee et al., describes the application of mathematical techniques to production scheduling at steel plants, one of the most difficult industrial scheduling problems. The costs involved in steel production are so large that improvement by even a fraction of a percent can result in savings of millions of dollars. The mathematical models, however, are very complicated—especially those reflecting the constraints of steelmaking. IBM has developed new techniques for dealing with these difficult problems. The paper describes how these new techniques, from operations research and artificial intelligence, are used to accomplish improved steel plant scheduling.

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Editor